

**Figure 4.12. EXPLORATORY DATA ANALYSIS:  
Future Costs of Environmental Pollution**

EM8906: The Globe and Mail, July 12, 1989, pages A1, A2

# Every family to pay for pollution: \$1,400-a-year bill falling due soon

## Cost of pollution cleanup hits home

BY CRAIG McINNES  
The Globe and Mail

Regardless of who is to blame, when the bill comes due for polluting the environment, everyone will have to pay, a leading actuarial consultant said yesterday.

And by the turn of the century, that bill could be \$1,400 a year for every Canadian family, according to a recent estimate by Infrometrica Ltd., an Ottawa-based consulting company

"We the people will ultimately pay the costs; it is simply a matter of how they are going to get to us," said Margaret Tiller, an actuarial consultant and president of Tiller Consulting Group of St. Louis, Mo. Ms. Tiller was part of a panel assessing environmental risks in the year 2000 at a Toronto forum sponsored by Canadian and U.S. actuaries.

The costs may be passed on through higher insurance premiums, higher taxes or higher priced goods and services, Ms. Tiller said.

A survey of actuaries – professionals who use statistics to assess risks – released at a news conference yesterday rated hazardous chemical wastes as the greatest environmental health hazard to the general population by the year 2000.

The majority of actuaries who responded to the survey also rated chemical wastes as the environmental risk likely to be most costly to society by the year 2000 – out-ranking radioactive wastes, ozone depletion, oil spills and the agricultural contamination of underground water supplies.

Most of the actuaries – 95 per cent – said the current clean-up mechanisms are inadequate to meet the costs of eradicating pol-

lution. More than half said the additional funds will come from taxes while less than a quarter of the respondents said that private industry will pay.

Only 11 per cent said the money will come from insurance companies. But any costs borne by insurers will be passed on to insurance purchasers, Ms. Tiller said. And those purchasers will in turn pass their increased costs to consumers.

Similarly, industry will pass on to consumers any cleanup costs they are forced to incur.

The second greatest health risk will be smoking, followed by radioactive wastes, fallout and radon, according to the survey, which was distributed to 1,200 actuaries in the United States and Canada and completed by 332 of them.

"Smokers have higher health costs, die younger and cause or exacerbate health problems in those around them," Ms. Tiller said. "Many of smokers' additional costs are borne by non-smokers."

In addition to assessing risks, actuaries can play a direct role in cleaning up the environment, said Robert Brown, president of the Canadian Institute of Actuaries.

Companies that handle hazardous materials may soon be able to reduce their liability insurance rates by instituting environmental safeguards based on actuarial assessments, he said.

"Then your premiums will be directly a function of how you are handling those hazardous materials. That means then there will be an economic incentive to be a responsible corporate citizen."

Insurance companies in Canada are in-

creasingly willing to provide pollution liability as part of their general coverage after shunning such policies in the early 1980s, Mr. Brown said.

In the Infrometrica study, the costs of already announced and projected environmental initiatives were added up and applied to economic growth projections through 2005.

The study assumes an aggressive pollution program in all provinces similar to the one that has been undertaken in Ontario. Such a program would result in additional capital costs of \$47- to \$48-billion by the end of the century for industry to stop polluting the environment, the study concludes.

That figure does not allow for any capital figure to reduce carbon dioxide emissions, which are believed to be contributing to the warming of the earth's atmosphere.

The net result of that cost will be a \$1,400 annual loss in purchasing power for Canadian families, according to the Infrometrica study, prepared by Infrometrica vice-president Carl Sonnen.

There would be offsetting financial benefits of reducing pollution, which have not been factored in because there is no information available what those benefits would be worth, Mr. Sonnen said.

"It is an absolute crying shame that we don't have any information that tells us what those benefits are because those benefits are the mirror of the damage that's being done."

"We're saying that we are damaging the economy through the environment, which is the sustainability argument, but as far as I know, we haven't got a clue what the amount of that damage is."

- 1 What is the *primary* measure of location given in the article EM8906 reprinted above? Give both a brief description of this measure *and* its value.
  - Briefly describe the *distribution* to which this measure refers.
  - Suggest, with reason(s), a plausible *shape* for this distribution.
  - Suggest, with reason(s), both a measure of *spread* for this distribution and, if possible, a plausible value for it.
- 2 What was the *source(s)* of the data which were gathered in the investigation and which provide the answers given in the article EM8906.
  - In light of these source(s), assess the likely severity of the *limitations* on the answers – distinguish between answers likely with acceptable and with *unacceptable* limitations in the question context.

(continued overleaf)

- ③ The fourth paragraph of the middle column of the article EM8906 mentions that "*.... the survey .... was distributed to 1,200 actuaries .... and completed by 332 of them.* What *non-response* rate (expressed as a percentage) does this represent?
- Suggest, in point form, plausible reasons why such a percentage of the actuaries surveyed might not have responded.
  - What is the *primary* effect of non-response at this level on the severity of limitations on survey answers? Explain briefly.
  - How do you think the sample survey questionnaire was distributed to the 1,200 actuaries? Briefly justify your surmise.
    - Comment briefly on any connection you see between the non-response rate and the method of distributing the questionnaire.
      - Suggest an *alternative* method of distributing the questionnaire and indicate briefly its advantage(s) and disadvantage(s).
        - ✦ If *you* were conducting this sample survey, describe briefly any change(s) you would make to its Plan.
  - Do you consider it likely that the phrase *.... and completed by 332 of them* is literally true? Explain briefly, including the statistical implications.

The article EM8906 reprinted overleaf on page 4.33 is used in Figure 4.12 of the STAT 220 Course Materials; it is also relevant to Part 8 of STAT 220 and Part 2 of STAT 332.